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AUTHORS

Yen-Hsien Lee
Tung-Yueh Pai
Ya-Ling Huang
Yu-Shan Lin

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Yen-Hsien Lee (Taiwan), Tung-Yueh Pai (Taiwan), Ya-Ling Huang (Taiwan), Yu-Shan Lin (Taiwan)

Foreign ownership, return volatility, and investment opportunities

Abstract

This study examines whether volatility and foreign shareholdings affected stock returns with investment opportunities (book assets, age, R&D expenditures and future sales growth) in the Taiwanese stock market from 4 January 1990 to 31 October 2013. The results indicate that the volatility-return relation (foreign shareholding-return relation) in the Taiwanese stock market is highly positive. Adding proxies for investment opportunities representing the firm value shows that the volatility-return (foreign shareholding-return) relation is sensitive to the firm size, firm age and future sales growth (firm size, R&D intensity, future sales growth and earnings flexibility). That is, a firm with large investment opportunities is highly sensitive to volatility and foreign shareholdings.

Keywords: real options hypothesis, foreign holding shares, volatility-return.
JEL Classification: G1, G3.

Introduction

In many researches, the relation between stock volatility and stock returns is widely documented. Previous research presents three arguments related to individual firms' stock volatility-return relation: negative, positive and no relation. Black (1976), Cheung and Ng (1992) and Bollerslev and Zhou (2006) find a negative relation between volatility and returns[1]. Bollerslev, Chou and Kroner (1992) and Nam and Krausz (2008) point out that there is no relation between volatility and returns. Merton (1973), French, Schwert and Stambaugh (1987), Campbell and Hentschel (1992) and Ludvigson and Ng (2007) find a significant positive volatility–return relation. Because there is no consistent conclusion in these studies, we construct further tests to analyze the volatility-return relation.

Firms taking advantage of their investment opportunities to format investment plans make investors offering capital affect the volatility-return relation. McDonald and Siegel (1986) point out that the value of a firm's real options increases with the volatility of an underlying process. If a firm's stock price reflects the value of the firm, then the return volatility-investment opportunity relation may be strong. Thus, we test whether investment opportunities affect the volatility-return relation or not.

Because of high growth power, emerging markets become foreign institution investors' investment target. From 1983, the Taiwanese market, belonging to an emerging market, started its stock market liberalization in 2003. Foreign investors have become increasingly important to the Taiwanese stock market. Thus, we test the foreign shareholding-return relation in Taiwan. There are three different kinds of arguments concerning the impact of foreign shareholdings on the stock market. Grinblatt and Keloharju (2000), Seasholes (2000) and Froot and Ramadorai (2001) find that foreign shareholdings generate positive returns in the stock market. However, Kang and Stulz (1997) indicate that there is no significant impact of foreign shareholdings on excess returns. Choe, Kho and Stulz (2001) and Hau (2001) point out that foreign institution investors' holdings have negative returns in the stock market. However, the research area includes different kinds of markets in these studies – developed markets or emerging markets – so foreign shareholdings have different effects on the stock markets. Huang and Shiu (2009) mention that the Taiwanese stock market is dominated by unknown and high trading frequency investors, so domestic investors like to pay attention to foreign information with information advantages. In addition, Ferreira and Matos (2008) indicate that foreign institutional investors prefer high firm value or firms that perform better. Thus, this study investigates the investment opportunities' effect on the foreign shareholding-return relation in the Taiwanese stock market.

Furthermore, we test the difference between firms with real options and firms with assets in place in the volatility-return relation and foreign shareholding-return relation. Taiwan is a "semiconductor kingdom" and the output value accounts for a large proportion of the GDP in Taiwan and has development power. Therefore, we use the electronics industry as a research focus to determine whether it really differs in the volatility-return relation and foreign shareholding-return relation.

Yen-Hsien Lee, Department of Finance, Chung Yuan Christian University, Taiwan.
Tung-Yueh Pai, corresponding author, Department of Institute of Management, Minghsin University of Science and Technology, Hsinchu, Taiwan.
Ya-Ling Huang, Department of Golden-Ager Industry Management, Chaoyang University of Technology, Taiwan.
Yu-Shan Lin, Department of Banking and Finance, Tamkang University, Taiwan.

[1] Black (1976) points out that the rise in individual firms' stock return volatility after a fall in stock prices is caused by the "leverage effect" hypothesis. Bollerslev and Zhou (2006) find that a negative relation between volatility and returns is not really different from the traditional ICAPM, but depends on the real model setting.

The empirical study contributes to the field of real options applied to the Taiwanese stock market volatility and foreign shareholding impact on stock returns. We find that the effects of investment opportunity and operating flexibility on the volatility-return and foreign shareholding-return relations are not all the same. For volatility, only the firm size, firm age and future sales growth are highly sensitive to the relation between volatility and return. For foreign shareholdings, the firm size, R&D intensity, future sales growth and earnings flexibility are highly sensitive to the relation between foreign shareholdings and returns. The electronics industry reduces the volatility-return and foreign shareholding-return relation. Under the CAPM and three-factor model, the higher the stock volatility (foreign shareholdings), the more excess returns from the firm.

The remainder of this paper is organized as follows. Section 1 discusses the data and the empirical model. Section 2 presents the empirical results. Final Section summarizes and concludes.

1. Methodology

1.1. Data. We use daily stock returns to estimate the volatility, factor loadings and monthly returns as the dependent variables in the regressions. All the data selected are Taiwanese stock (not including TDR) and contain approximately 800 firms, from Taiwan Economic Journal datatbase. The time frame of our analysis is from January 1990 to October 2013. Following Ang, Hodrick, Xing, and Zhang (2006), we eliminate financing from our sample. The stock return data in our sample contain about 2 million daily observations, the foreign shareholdings contain about 14 million monthly observations and the measures of investment opportunities variable contains about 17 million observations. Table 1 shows the original data formula.

Table 1. Original data

Data	Frequency	Database definition
Trading volume	Monthly	The trading volume per stock
Closing price	Monthly	The closing price at the end of the month
Firm age	Annually	The difference between the current year and the founding year
R&D expenditure	Annually	The annual R&D expenditure
Sales revenue	Quarterly, Annually	The sales-sales returns and allowances
Earnings per share	Quarterly	The weighted average number of shares in the period, not retroactive adjustment of shares
Earnings announcement day	Quarterly	Financial statements' announcement in special event date databases

1.2. Measurement. Following Duffe (1995) and Ang et al. (2006, 2009), we calculate firms' volatility as below:

$$V_{i,t} = \sqrt{\frac{\sum_{\tau \in t}(r_{i,\tau} - \overline{r_{t,t}})^2}{n_t - 1}}, \quad (1)$$

where $r_{i,\tau}$ is firm i's return on day τ, $\overline{r_{t,t}}$ is the mean of firm i's monthly return, n_t is the observation of the monthly return and $V_{i,t}$ is firm i's monthly stock volatility.

We follow the previous literature on asset pricing models, such as Fama and French (1993), Jegadeesh and Titman (1993) and Cooper, Gulen and Schill (2008), using the log market equity (MV), log book price ratio (BM) and historical returns (PR) as firm characteristics. Market equity is the stock price at the end of June multiplied by the number of shares outstanding; the book price is the reciprocal of "PBR-TEJ" in the TEJ database; and historical returns mean the by-and-hold returns for the past six months. In addition, Karpoff (1987) finds a positive relation between stock returns and trading volume, so we also include the trading volume ($Vu_{i,t}$). The measure of $Vu_{i,t}$ is the stock trading volume divided by the number of shares outstanding. We estimate the coefficient on the market portfolio return in equation (2), $\eta_{i,t}$, called beta. The estimation is as follows:

$$ER_{i,\tau} = \alpha_{i,t} + \eta_{i,t}(r_{m,\tau} - r_{f,\tau}) + \varepsilon_{i,\tau}, \quad (2)$$

where $r_{f,\tau}$ is the risk-free rate in month t, $r_{m,\tau}$ is the market portfolio daily weighted return in month t on day τ and $ER_{i,\tau}$ is the excess return of firm stock $(r_{i,\tau} - r_{f,\tau})$.

The proxy variables are the investment opportunities that may affect the volatility-return relation and foreign shareholding-return relation[2]. Besides the four investment opportunities, we ascertain whether the firm value of function of a firm that has an investment opportunity will be convex[3]. In short, this study uses two data: earnings and sales. By applying Mils (1984) and rewriting the way of calculating the flexibility, the equations are as follows:

1.2.1. Earnings flexibility.

$$ExpE_{i,\tau} = Ea_{i,\tau-4} + \\ + \sum_{n=1}^{8}(Ea_{i,\tau-n} - Ea_{i,\tau-n-4})/8, \quad (3)$$

[2] We follow Grullon, Lyandres and Zhdanov (2012), choosing firm size, firm age, R&D intensity and future sales growth as investment opportunities.

[3] We follow Grullon, Lyandres and Zhdanov (2012), choosing operating flexibility as another investment opportunity.

$$SUE_{i,\tau} = \frac{Ea_{i,\tau} - ExpE_{i,\tau}}{StdE_{i,\tau}}, \quad (4)$$

$$AbR_{i,\tau} = \alpha_{i,t} + \beta_{i,t} SUE_{i,\tau} + \\ + FlexE_t SUE_{i,\tau}^2 + \varepsilon_{i,\tau}, \quad (5)$$

where $Ea_{i,\tau}$ is the earnings per share for firm i in quarter τ, $ExpE_{i,\tau}$ is the expected value of earnings per share in quarter τ, $AbR_{i,\tau}$ is firm i's stock return on the earnings announcement date in quarter τ minus the expected return on the same day and the expect return equals the beta estimated by equation (2) in the month before the month of the earnings announcement day multiplied by the market portfolio return on the earnings announcement day. Equation (4) is the formula for standardized unexpected earnings. $StdE_{i,\tau}$ is the standard deviation of earnings per share from quarter (τ-8) to (τ-1) and $SUE_{i,\tau}$ is the standardized unexpected earnings. The purpose of equation (5) is to calculate the estimated value of the flexibility of the earnings; $FlexE_t$ is the estimated value of earnings flexibility.

1.2.2. Sales flexibility:[4]

$$ExpS_{i,\tau} = Sa_{i,\tau-4} + \\ + \sum_{n=1}^{8} (Sa_{i,\tau-n} - Sa_{i,\tau-n-4}) / 8, \quad (6)$$

$$SUEs_{i,\tau} = \frac{Sa_{i,\tau} - ExpS_{i,\tau}}{StdS_{i,\tau}}, \quad (7)$$

$$AbR_{i,t} = \alpha_{i,t} + \beta_{i,t} SUEs_{i,\tau} + \\ + FlexF_t SUEs_{i,\tau}^2 + \varepsilon_{i,\tau}, \quad (8)$$

where $Sa_{i,\tau}$ is firm i's net sales in quarter τ and $ExpF_{i,\tau}$ is the expected value of operating revenues in quarter τ.

1.3. Models. *1.3.1. Investment, volatility (foreign shareholdings) and returns.* We assume that the stock volatility or foreign shareholdings are correlated with the returns and substitute Fama and MacBeth's (1973) regression:

$$ER_{i,t} = \alpha_t + \beta_t V_{i,t} + \gamma_t \eta_{i,t} + \\ + \vec{\delta_t} \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}, \quad (9)$$

$$ER_{i,t} = \alpha_t + \beta_t F_{i,t} + \gamma_t \eta_{i,t} + \\ + \vec{\delta_t} \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t_{i,t}}. \quad (10)$$

Where $V_{i,t}$ and $F_{i,t}$ are the stock volatility and foreign shareholdings and $\eta_{i,t}$ estimates the coefficient on the market portfolio return in equation (2) and is called beta. $\chi_{i,t}$ is the firm characteristics (including the market equity, price-to-book ratio and past returns) and $Vu_{i,t}$ is the ratio of stock trading per stock.

Adding proxy variables (investment opportunities or operating flexibilities) to the volatility-return and foreign shareholding-return regressions and formatting the Fama-MacBeth cross-sectional regression produces the following equations:

$$ER_{i,t} = \alpha_t + \beta_t V_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta_t} \chi_{i,t} + \\ + \zeta_t Vu_{i,t} + v_{i,t} G_{j,i,t} + \varepsilon_{i,t}, \quad (11)$$

$$ER_{i,t} = \alpha_t + \beta_t F_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta_t} \chi_{i,t} + \\ + \zeta_t Vu_{i,t} + v_{i,t} G_{j,i,t} + \varepsilon_{i,t}, \quad (12)$$

where $G_{j,i,t}$ are investment opportunities (firm size, firm age, R&D intensity, future sales growth) or operating flexibility (including earnings flexibility, marketing flexibility) multiplied by the foreign shareholdings ($F_{i,t}$) or volatility ($V_{i,t}$); the other variables are as described before.[5]

We test the volatility-return relation and foreign shareholding-return relation by using another method – determining whether the firm value differs or not with high investment opportunities. In Taiwan, the electronics industry has high investment opportunities. Thus, we set up the following equations:

$$ER_{i,t} = \alpha_{i,t} + \beta_{1,i,t} V_{i,t} + \beta_{2,i,t} D_i F_{i,t} + \\ + \gamma_t \eta_{i,t} + \vec{\delta_t} \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}. \quad (13)$$

$$ER_{i,t} = \alpha_{i,t} + \beta_{1,i,t} F_{i,t} + \beta_{2,i,t} D_i V_{i,t} + \\ + \gamma_t \eta_{i,t} + \vec{\delta_t} \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}. \quad (14)$$

Where the D_i dummy variable is equal to 1 if a firm belongs to the electronics industry; otherwise, it is 0.

1.3.2. The CAPM, asset pricing model and volatility to returns. Da, Guo and Jagannathan (2012) discuss the possibility that the CAPM may have weak performance in explaining firms with multiple investment options. Because the CAPM cannot be conducted at different time points, firms' investment decisions must be taken into consideration. Thus, we use the CAPM (1963) and Fama and French's (1993) three-factor model to explain the potential development opportunities for mixed firm rewards

[4] The estimation is the same as earnings flexibility, only replacing earnings per share with sales.

[5] j = 1 to 6 are firm size, firm age, R&D intensity, future sales growth, earnings flexibility and marketing flexibility.

(real options) and operating assets. To find out the value of a firm's sensitivity, we perform calculations for every three years using the following formula:

$$ER_{i,t} = \alpha_{i,t} + \beta_{i,t}(r_{m,t} - r_{f,t}) + \gamma_{i,t}V_{i,t} + \varepsilon_{i,t}. \quad (15)$$

$$ER_{i,t} = \alpha_{i,t} + \beta_{i,t}(r_{m,t} - r_{f,t}) + \gamma_{i,t}F_{i,t} + \varepsilon_{i,t}. \quad (16)$$

After calculating equations (15) and (16), we sort firms by volatility or foreign shareholdings ($\gamma_{i,t}$) and divide them into five quintiles. Then, within each quintile, we sort the firms by the value of the variable ($\beta_{i,t}$) that represents the assets in place as well as dividing them into five quintiles. We compute the monthly returns of the resulting 25 CAPM portfolios and estimate the regressions as follows:

$$ER_{p,t} = \alpha_p + \beta_p(r_{m,t} - r_{f,t}) + \varepsilon_{i,t}. \quad (17)$$

Where p is the resulting 25 CAPM portfolios estimated by equations (15) and (16).

We also perform similar tests of the Fama and French (1993) three-factor model for the resulting 25 portfolios discussed above:

$$ER_{p,t} = \alpha_p + \beta_{1,p}(r_{m,t} - r_{f,t}) + \\ + \beta_{2,p}HML_t + \beta_{3,p}SMB_t + \varepsilon_{i,t}. \quad (18)$$

Where HML_t is the low minus high market capitalization and SMB_t is the high minus low book-to-market ratio.

2. Empirical results

2.1. Summary statistics. Table 2 presents the summary statistics of the major variable. After hand collection, there are 824 firms overall; for operational flexibility (including earnings flexibility and sales flexibility) there are 68,941 observations; for investment opportunities (including firm size, firm age, R&D intensity and future sales growth) there are 81,494 observations; for stock volatilities there are 77,711 observations; and for foreign shareholdings there are 79,293 observations. The Taiwanese stock mean excess return is -2% per month or -24% per year. The mean stock volatility is 2.6%, and its range is ±1.078%. The mean foreign institution holding is 0.083% with a standard deviation of ±0.123%. This shows that the range of volatility and foreign holding shares is not so great. The mean of firm size is about NT$66 million with a mean age of about 25 years, R&D intensity of about 2.1% and about 87% of future sales growth. Compared with Grullon, Lyandres and Zhdanov (2012), who use U.S. firm data, the figures are 28 years of age, future sales growth of 281%, a scale of $29 million and R&D intensity of 11%. For the Taiwanese market, the firm size, firm age, future sales growth and R&D intensity are relatively small.

Table 2. Summary statistics

Variable	Obs.	Mean	SD	Maximum	Minimum
ER	78.294	-2.003	15.595	158.332	-154.316
F	79.293	0.083	0.123	0.818	0.000
V	77.711	2.636	1.078	11.553	0.000
BA	81.494	16.325.155	46.790.574	833.471.970	138.975
Age	81.494	25.685	12.152	63.000	0.000
R&D	81.494	0.021	0.033	0.495	0.000
Ss	81.494	0.878	30.781	1829.232	-2.769
FlexS	68.941	23.838	2111.844	315570.396	0.000
FlexE	68.941	5.430	38.239	2468.392	0.000

Notes: Table 2 shows the summary statistics. ER is excess return, F is foreign shareholdings, V is volatility, BA is firm size, Age is firm age, R is R&D intensity, Ss is future sales growth, FlexS is sales flexibility and FlexE is earnings flexibility.

Table 3 shows the Pearson correlation coefficient of all the variables. The range sets from 0 to 0.4 mean low to moderate correlation. The relation between major variables (including volatility and foreign shareholdings) and proxy variables (including investment opportunities and operational flexibility) is mostly low correlation. Firstly, the correlation of foreign shareholdings and earnings flexibility is -0.01, meaning that foreign shareholdings are negatively correlated with earnings flexibility. On the contrary, foreign shareholdings are positively correlated with the other variables. Secondly, the correlation between stock volatility and firm size or firm age is -0.075 or -0.106, meaning that the volatility is negatively correlated with the firm size or firm age. Conversely, the stock volatility is positively correlated with the other variables. Finally, Table 3 shows a negative correlation between excess returns and earnings flexibility (-0.016) and a positive correlation with the other variables.

Table 3. Correlation

	ER	F	V	BA	Age	R	Ss	FlexS	FlexE
ER	1	0.125	0.03	0.006	0.009	0.029	0.002	0.010	-0.016
F		1	-0.023	0.017	-0.014	0.010	0.005	0.002	-0.007
V			1	-0.075	-0.106	0.063	0.011	0.013	0.023

Table 3 (cont.). Correlation

	ER	F	V	BA	Age	R	Ss	FlexS	FlexE
BA				1	0.037	-0.018	-0.001	-0.001	0.002
Age					1	-0.365	0.004	0.000	0.011
R						1	-0.013	-0.006	-0.020
Ss							1	0.000	-0.002
FlexS								1	0.005
FlexE									1

Notes: Table 3 shows the correlations. ER is excess returns, F is foreign shareholdings, V is volatility, BA is firm size, Age is firm age, R is R&D intensity, Ss is future sales growth, FlexS is sales flexibility and FlexE is earnings flexibility.

2.2. Investment opportunity, volatility, foreign holdings and returns. In Table 4, Panel A and Panel B are estimated from equations (9) and (10) – regressions that analyze the volatility-return and foreign shareholding-return relation. Comparing models 1, 3 and 5 with models 2, 4 and 6, we find that adding volatility or foreign shareholdings improves the explanatory power significantly. The volatility-return relation and foreign shareholding-return relation are significant and positive, meaning that when the volatility or foreign shareholdings increase, the excess return will also increase. The beta, book-to-market ratio, trading volume and past returns become significant in models 5 and 6. Furthermore, the R^2 is the highest value in all the models of Panel A and Panel B. Therefore, we will use model 6 as the base in the following empirical tests.

In Table 5, Panel A and Panel B are estimated from equations (11) and (12) to examine whether the volatility-return or foreign shareholding-return relations are affected by proxies (including investment opportunities/operational flexibility) or not. Comparing Table 5 with model 6 in Table 4, it is apparent that except for the investment portfolio returns and book-to-market ratio, the other variables do not change significance when investment opportunities or operational flexibility are added.

For volatility, except for model 11, the *p* values of all the operational flexibilities and R&D intensities are not significant, meaning that the volatility-return relation will not be affected. The estimated coefficients of firm size, firm age and future sales growth are 0.679, 0.196 and 7.779, and the *T* values are significant, showing that the volatility-return relation is positively affected. When the firm size, firm age or future sales growth increases, the sensitivity of volatility to excess returns will also increase. For foreign shareholdings, the estimated coefficients of firm size, future sales growth and earnings flexibility are 0.392, 18.19 and 3.403 and significant, which means that the foreign shareholding-return relation will change more. However, the R&D intensity coefficient is negative (-0.249) and significant, which means that the R&D intensity increase will weaken the foreign shareholding-return relation. Although the estimated coefficients of firm age and sales flexibility are 0.166 and 6.505, the T value is not significant, which means that the firm age and sales flexibility do not change the foreign shareholding–return relation. Overall, the inclusion of investment opportunities/operational flexibility in the foreign shareholding-return relation makes the explanatory power states stable and the estimated coefficients of variables' significance change less. When the firm size, R&D intensity and earnings flexibility increase, the foreign shareholdings increase. Anne and Jeanjean (2006) find a negative relation between R&D and returns. Because of this, foreign investors may reduce their shareholdings to avoid losses.

Table 6 shows the estimated coefficient of equations (13) and (14) to examine whether or not the electronics industry has a different volatility-return relation and foreign shareholding-return relation. For the volatility-return relation equation, the estimated coefficient of volatility is higher when the variable (D1) is added. The estimated value of D1 is -0.313 and significant, and the estimated coefficients of the other variables are almost the same as in the original model. This shows that the electronics industry reduces the volatility-return relation. For the foreign shareholding-return relation equation, the estimated coefficient volatility increases from 1.569 to 2.227 and the other variables remain the same when considering the electronics industry. For foreign shareholdings, the estimated coefficient of volatility is also higher when the variable (G1) is added. The estimated value of D1 is -0.708 and extremely significant, and the estimated coefficients of the other variables are almost the same as in the original model. In short, the electronics industry reduces the foreign shareholding-return relation. The leverage effect may be able to explain this. Christie (1982) finds that reducing the stock price causes a leverage increase, also increasing the volatility.

Table 4. Volatility/foreign shareholdings and return regressions

Panel A: Volatility and returns regressions												
Model	1		2		3		4		5		6	
	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value
V			2.353***	(6.64)			2.459***	(7.02)			1.37***	(4.02)
Beta	0.634	(1.54)	-0.034	(-0.09)	0.486	(1.31)	-0.061	(-0.18)	-0.665**	(-1.99)	-0.569*	(-1.66)
MV	-0.404***	(-4.61)	-0.265***	(-3.26)	-0.409***	(-4.77)	-0.314***	(-3.95)	-0.255***	(-3.21)	-0.23***	(-3.03)
BM	0.025	(0.06)	0.011	(0.03)	0.175	(0.46)	-0.036	(-0.11)	0.744**	(2.17)	0.477	(1.61)
PR					0.205	(0.31)	-0.746	(-1.23)	-1.471**	(-2.48)	-1.847***	(-3.14)
Vu									9.778***	(12.06)	8.711***	(12.92)
R^2	0.11		0.214		0.133		0.232		0.207		0.267	
Panel B: Foreign institutional holdings and returns regressions												
F			1.573***	(12.99)			1.574***	(13.73)			1.569***	(14.54)
Beta	0.634	(1.54)	0.544	(1.36)	0.486	(1.31)	0.394	(1.1)	-0.665**	(-1.99)	-0.762**	(-2.39)
MV	-0.404***	(-4.61)	-0.406***	(-4.69)	-0.409***	(-4.77)	-0.419***	(-4.98)	-0.255***	(-3.21)	-0.268***	(-3.46)
BM	0.025	(0.06)	0.087	(0.23)	0.175	(0.46)	0.196	(0.52)	0.744**	(2.17)	0.772**	(2.26)
PR					0.205	(0.31)	-0.051	(-0.08)	-1.471**	(-2.48)	-1.713***	(-2.9)
Vu									9.778***	(12.06)	9.866***	(12.37)
R^2	0.11		0.139		0.133		0.162		0.207		0.234	

Notes: Table 4 shows $ER_{i,t} = \alpha_t + \beta_t V_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta}_t \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}$ and $ER_{i,t} = \alpha_t + \beta_t F_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta}_t \chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t_{i,t}}$. In this table, $V_{i,t}$ and $F_{i,t}$ are the stock volatility and foreign shareholdings. We estimate the coefficient on the market portfolio return in equation (2), $\eta_{i,t}$, called beta. $\chi_{i,t}$ is the firm characteristics (including market equity, price-to-book ratio and past returns) and $Vu_{i,t}$ is the ratio of stock trading per stock. R^2 is the mean value of regressions in the same models' R^2.

Table 5. Investment opportunities, volatility or foreign shareholdings and return regressions

Panel A: Investment opportunities, volatility and returns regressions												
Model	7 (G1)		8 (G2)		9 (G3)		10 (G4)		11 (G5)		12 (G6)	
	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value	Estimation	*t* value
V	1.593***	(4.77)	1.411***	(4.18)	1.364***	(4.04)	1.462***	(4.28)	1.469***	(4.08)	1.396***	(4.15)
Beta	-1.084***	(-3.3)	-0.608*	(-1.83)	-0.569*	(-1.71)	-0.575*	(-1.71)	-0.535	(-1.55)	-0.624*	(-1.87)
MV	-1.173***	(-10.17)	-0.229***	(-2.99)	-0.211***	(-2.77)	-0.203***	(-2.61)	-0.235***	(-3.11)	-0.217***	(-2.84)
BM	0.096	(0.33)	0.180	(0.65)	0.479*	(1.70)	0.540*	(1.82)	0.484	(1.62)	0.482	(1.64)
PR	-3.037***	(-5.21)	-2.078***	(-3.65)	-1.844***	(-3.23)	-1.902***	(-3.21)	-1.951***	(-3.31)	-1.839***	(-3.13)
Vu	8.417***	(12.65)	8.828***	(13.26)	8.517***	(12.89)	8.653***	(12.79)	8.742***	(13.06)	8.653***	(13.05)
G_j	0.679***	(9.69)	0.196***	(3.11)	0.042	(1.00)	7.779**	(2.56)	10.797	(1.30)	0.171	(0.42)
R^2	0.288		0.283		0.278		0.275		0.274		0.275	
Panel B: Investment opportunities, foreign shareholdings and returns regressions												
F	1.379***	(12.72)	1.702***	(14.76)	1.584***	(14.39)	1.916***	(11.13)	1.646***	(3.19)	1.784***	(12.96)
Beta	-0.775**	(-2.4)	-0.788**	(-2.48)	-0.738**	(-2.29)	-0.796**	(-2.52)	-0.768**	(-2.41)	-0.807**	(-2.56)
MV	-0.293***	(-3.81)	-0.266***	(-3.45)	-0.272***	(-3.49)	-0.263***	(-3.36)	-0.271***	(-3.48)	-0.264***	(-3.39)
BM	0.791**	(2.31)	0.757**	(2.21)	0.771**	(2.25)	0.799**	(2.35)	0.765**	(2.24)	0.755**	(2.2)
PR	-1.776***	(-3.02)	-1.782***	(-3.06)	-1.747***	(-2.97)	-1.717***	(-2.92)	-1.802***	(-3.05)	-1.78***	(-3.04)
Vu	9.931***	(12.51)	9.948***	(12.47)	9.897***	(12.36)	9.852***	(12.18)	9.921***	(12.55)	9.936***	(12.5)
G1	0.392***	(4.95)	0.166	(1.58)	-0.249***	(-2.71)	18.19**	(2.23)	6.505	(0.15)	3.403**	(2.32)
R^2	0.24		0.239		0.239		0.241		0.241		0.243	

Notes: Table 5 shows $ER_{i,t} = \alpha_t + \beta_t V_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta}_t \chi_{i,t} + \zeta_t Vu_{i,t} + v_{i,t} G_{j,i,t} + \varepsilon_{i,t}$ and $ER_{i,t} = \alpha_t + \beta_t F_{i,t} + \gamma_t \eta_{i,t} + \vec{\delta}_t \chi_{i,t} + \zeta_t Vu_{i,t} + v_{i,t} G_{j,i,t} + \varepsilon_{i,t}$. In this table, G_j = G1 to G6 are the product of volatility (foreign shareholdings) and one of the proxy variables (firm size, firm age, R&D intensity, future sales growth, sales flexibility and earnings flexibility); the other variables are described in Table 2.

Table 6. Electronics industry, volatility or foreign shareholdings and returns

Volatility-return relation equation					Foreign shareholding-return relation equation				
	Estimation	*t* value	Estimation	*t* value		Estimation	*t* value	Estimation	*t* value
V	1.37***	(4.02)	1.536***	(4.56)	V	1.569***	(14.54)	2.227***	(11.27)
D1			-0.313*	(-1.71)	D1			-0.708***	(-3.56)
Beta	-0.569*	(-1.66)	-0.347	(-1.15)	Beta	-0.762**	(-2.39)	-0.763**	(-2.41)
MV	-0.23***	(-3.03)	-0.204***	(-2.68)	MV	-0.268***	(-3.46)	-0.268***	(-3.48)

Table 6 (cont.). Electronics industry, volatility or foreign shareholdings and returns

Volatility-return relation equation					Foreign shareholding-return relation equation				
	Estimation	*t* value	Estimation	*t* value		Estimation	*t* value	Estimation	*t* value
BM	0.477	(1.61)	0.134	(0.54)	BM	0.772**	(2.26)	0.769**	(2.26)
PR	-1.847***	(-3.14)	-2.201***	(-4.09)	PR	-1.713***	(-2.9)	-1.736***	(-2.95)
Vu	8.711***	(12.92)	8.587***	(13.87)	Vu	9.866***	(12.37)	9.87***	(12.36)
R^2	0.267		0.300		R^2	0.234		0.24	

Notes: Table 6 shows $ER_{i,t} = \alpha_{i,t} + \beta_{1,i,t}V_{i,t} + \beta_{2,i,t}D1_iF_{i,t} + \gamma_t\eta_{i,t} + \vec{\delta}_t\chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}$ and $ER_{i,t} = \alpha_{i,t} + \beta_{1,i,t}F_{i,t} + \beta_{2,i,t}D1_iF_{i,t} + \gamma_t\eta_{i,t} + \vec{\delta}_t\chi_{i,t} + \zeta_t Vu_{i,t} + \varepsilon_{i,t}$. D1 is a dummy variable equal to 1 if a firm belongs to the electronics industry; otherwise, it is 0. The other variables are described in Table 4.

2.3. Real options and asset pricing models. This section supplements the capital asset pricing model and ranks by real option volatility to observe the performance of the volatility-return relation and foreign shareholding-return relation. First, we sort the data by volatility or foreign shareholdings and allocate them to five quintiles. High volatility or foreign shareholdings mean a high proportion of real options (investment opportunities). Conversely, low volatility or foreign shareholdings mean a high proportion of assets in place. Within each quintile, we sort the firms into five quintiles according to the estimated market portfolio returns. In total, there are 25 portfolios in the capital asset pricing model (CAPM) and the 3-factor model[6].

The purpose of Table 7 Panel A and Panel B is to observe the volatility-return relation and foreign shareholding-return relation under the CAPM. Intercept means the firm stock returns deducting the market returns. Within the same volatility or foreign shareholdings portfolio, we cannot find regular changes in the excess returns. For all the volatilities and all the foreign holding shares, we can still see that the higher the volatility or foreign shareholdings, the more significant the excess returns. This means that when applying the capital asset pricing model, we can still find that firms with investment opportunities have higher excess returns.

Table 7. Capital asset pricing models – volatility or foreign shareholdings and returns

Panel A: Capital asset pricing model – volatility and returns											
Rank beta Rank coeff. on V		Large		2		3		4		Small	
Intercept	Large	-0.002	(-0.008)	0.384	(1.42)	0.963***	(3.377)	0.186	(0.595)	-0.287	(-0.88)
β_p		0.845***	(21.437)	1.026***	(26.056)	1.234***	(29.483)	1.347***	(29.168)	1.352***	(28.389)
Intercept	2	0.786***	(3.067)	0.599**	(2.574)	0.407	(1.593)	0.281	(1.063)	0.346	(1.123)
β_p		0.98***	(25.942)	1.019***	(29.696)	1.112***	(29.596)	1.291***	(33.511)	1.397***	(31.063)
Intercept	3	0.917***	(3.267)	0.883***	(3.737)	0.972***	(4.136)	0.167	(0.636)	-0.009	(-0.029)
β_p		1.105***	(26.8)	0.98***	(28.352)	1.068***	(31.111)	1.158***	(29.584)	1.321***	(28.613)
Intercept	4	0.507**	(2.109)	0.222	(0.93)	1.059***	(4.234)	0.175	(0.629)	0.469	(1.615)
β_p		0.907***	(25.838)	1.001***	(28.364)	1.183***	(32.426)	1.233***	(30.374)	1.301***	(30.529)
Intercept	Small	0.815***	(2.906)	0.599**	(2.28)	0.468*	(1.792)	0.61**	(2.094)	-0.287	(-0.976)
β_p		1.015***	(24.928)	1.036***	(26.828)	1.131***	(29.645)	1.297***	(30.284)	1.405***	(32.43)
Panel B: Capital asset pricing model – foreign shareholdings and returns											
Rank beta Rank coeff. on F		Large		2		3		4		Small	
Intercept	Large	0.314	(1.058)	0.305	(1.296)	0.235	(0.934)	0.242	(0.965)	-0.388	(-1.327)
β_p		0.855***	(19.712)	0.975***	(28.068)	1.108***	(30.166)	1.253***	(34.383)	1.335***	(31.788)
Intercept	2	0.159	(0.665)	0.531**	(2.521)	0.701***	(2.902)	0.394	(1.634)	0.517*	(1.834)
β_p		0.875***	(24.831)	0.899***	(28.918)	1.135***	(32.02)	1.258***	(35.701)	1.277***	(31.396)
Intercept	3	0.219	(0.925)	0.792***	(3.652)	0.685***	(2.939)	0.793***	(3.178)	0.648**	(2.103)
β_p		0.857***	(24.833)	1.029***	(32.285)	1.187***	(35.108)	1.263***	(35.105)	1.433***	(32.176)
Intercept	4	0.348	(1.517)	0.66***	(2.857)	1.05***	(4.069)	0.833***	(3.081)	0.272	(0.901)
β_p		0.963***	(29.089)	1.027***	(30.654)	1.144***	(30.414)	1.295***	(32.797)	1.338***	(30.383)
Intercept	Small	0.03	(0.11)	0.424	(1.59)	0.355	(1.259)	0.547*	(1.829)	-0.289	(-0.952)
β_p		0.974***	(24.532)	1.133***	(29.035)	1.204***	(29.318)	1.377***	(31.489)	1.364***	(31.186)

Notes: In Table 7, Panel A and Panel B show the volatility–return relation and foreign shareholdings relation under the CAPM. The regression is as follows: $ER_{p,t} = \alpha_p + \beta_p(r_{m,t} - r_{f,t}) + \varepsilon_{i,t}$, where p is the resulting 25 CAPM portfolios sorted by equations (15) and (16). The portfolios are the intersections of 5 portfolios formed of firms by volatility or foreign holding shares ($\gamma_{i,t}$) and 5 portfolios formed of firms by the value of the variable ($\beta_{i,t}$).

[6] We also use Fama and French's (1993) three-factor model to test the volatility–return relation and foreign shareholding–return relation. The empirical results show a similar situation: the excess returns are concentrated in high volatility or foreign shareholdings.

Conclusion

The main objective of this study is to discuss the investment opportunities' or operating flexibilities' effect on the volatility-return relation and foreign shareholding-return relation. Firstly, we find the volatility-return relation and foreign shareholding-return relation (without investment opportunities) by using the Fama-MacBeth cross-section regression. Secondly, to determine whether real options affect the volatility-return relation and foreign shareholding-return relation or not, we use proxies such as the firm size, firm age, R&D intensity, future sales growth, earnings flexibility and sales flexibility. Thirdly, we test whether or not the volatility-return relation and foreign shareholding-return relation are different when firms have growth power. Lastly, we find the effects of real options present in asset pricing models.

The empirical results provide evidence documented by Duffee (1995), who finds a significant positive volatility-return relation and foreign shareholding-return relation. Consistent with Grullon, Lyandres and Zhdanov (2012), we find that firms with investment opportunities mean firms with real options. This study suggests that real options have some effects on the volatility-return relation and foreign shareholding-return relation. For volatility, the firm size, firm age and future sales growth are highly sensitive to the relation. For foreign shareholdings, the firm size, firm R&D intensity, future sales growth and earnings flexibility are highly sensitive to the relations. However, the volatility-return relation and foreign shareholding-return relation are weaker in real option-intensive industries in Taiwan. Finally, calculating an asset pricing model, we find that it performs better within firms with a strong volatility-return relation and foreign shareholding-return relation. In general, our findings support the real options explanation for a positive volatility-return relation and foreign shareholding-return relation.

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